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ABSTRACT

This paper discusses some basic assumptions and issues concerning web-based surveys. Discussion includes: assumptions regarding cost and ease of use; disadvantages of web-based surveys, concerning the inability to compensate for four common errors of survey research: coverage error, sampling error, measurement error and nonresponse error; and web-based survey design. The paper concludes that based on the research thus far on web-based surveys, the following features are recommended for online survey products: (1) provide the option to include a progress indicator on the survey; (2) provide a method for respondents to print a printer-friendly version of the survey; (3) provide the researcher flexibility in the design and formatting of the survey; and (4) provide methods of authentication for probability samples such as password protection or PIN numbers. Two appendixes include "Criteria for Evaluating Web Sites (Southern Regional Education Board)" and a table of 'Principles for the Design of Web Surveys" (Dillman, Tortura, and Bowker, 1998). (Contains 18 references.) (AEF)

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Introduction to the Application of Web-Based Surveys

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Introduction to the Application of Web-Based Surveys
By Annemarie Timmerman

Introduction

Although still evolving, the Internet has been used for survey research in a variety of ways and for different purposes (Kay and Johnson, 1999). The Internet with its almost instantaneous transmission of data and communications provides unlimited opportunities for researchers conducting survey research. While a breadth of literature has been written on the methodological concerns with electronic surveys (Manfreda, Batagelj, and Vehova, 2002) standards to control for sampling error, user-response error and measurement error in online survey research are still being decided. As the use of online survey research grows and as commercial online survey products are developed deciphering the drawbacks and the assets in web-based surveys becomes increasingly important.

Over the last decade, electronic surveys have evolved from disk-by-mail surveys, to e-mails with embedded or attached surveys and finally to web-based surveys posted on the Internet (Shannon, et. al., 2002). With web-based surveys, participants are usually notified by e-mail to participate in the survey. The e-mail generally includes a link to the URL (uniform resource locator) web address of the survey. The focus of this article is on web-based surveys.

Unique Qualities

As a survey tool, web-based surveys have qualities similar to print surveys, interview surveys and telephone surveys, as well as qualities unique only to web-based tools. Like print surveys, web-based surveys are visual in nature. However, increased manipulation of font size, color, layout, graphics, and animation expand the visual language of web-based surveys over print (Cooper, 2000).

Like paper surveys and IVR (individual voice response) telephone surveys, web-based surveys are self-administered questionnaires. Redline and Dillman (1999) present the complexity of skip-pattern designs and respondent navigation techniques offered in self-administered surveys. Web-based surveys and online survey tools offer a host of skip-pattern designs that can exasperate or simplify the navigation through a survey for the respondent depending on the quality of the technical design of the web-based survey (Dillman, Tortura, and Bowker, 1998).

In this paper, we discuss some basic assumptions and issues concerning web-based surveys. Several assumptions regarding the advantages of web-based surveys will be addressed. Issues pertaining to web-based surveys will center on sampling error, measurement error, and no response error. Finally, we will look at some critical aspects of web-based survey design and recommendations for online survey tools.

Assumptions

Cost

Lower costs are often presented as one of the benefits of Internet surveys (Dillman, 2000). However, the cost benefit of online surveys versus paper surveys is dependent on which items are included in the cost analysis. In an analysis of the cost of paper surveys vs. web-based surveys in a Students Life Experiences Survey study, Schaefer determined that the cost of disseminating a paper survey was $2.07 per student while the cost of the web-based survey was $.88 per student (Gunn, 2002). While Schaefer's analysis of the costs of the paper survey versus the web-based survey are certainly accurate, the population surveyed needs to be considered. University students have greater access to computers and the Internet than the general population. The technology infrastructure and online support network that exists in a university environment does not extend to other populations, specifically in rural, low-income populations. Generally, the Internet access and the use of the university's infrastructure are free to students and the faculty researchers. A study by Asch concluded that web-based surveys appear to be economical when they are the only mode of response with postal mail used only as a follow-up to non-respondents and over 580 responses are obtained over the web (Schonlau, Fricker and Elliott, 2001). It would be difficult to use web-based surveys as the only method of data collection among rural populations where Internet access is less available and obtain that high of a response rate. Moreover, there are likely to be additional Internet access costs for rural populations that will prohibit a high response rate.

Ease of Use

While well-designed web-based surveys may eliminate some of the navigation difficulties found in print surveys, they include an additional set of skills unnecessary in print, interview or telephone surveys.

Before participating in any self-administered web-based survey, participants need basic computer and Internet browsing skills. Lack of these skills hinders participants from completing web-based surveys. Where researchers have offered both a web-based and a print version of a survey, some participants choose to complete the print version (Zhang, 1999). Even self-reported active users of the Internet often opted for a postal mail survey (Zhang, 1999). Additionally, access to Internet technology varies within a population. Incompatibility issues with hardware and software, varying Internet access speeds, and the look and feel of different web browsers compound the frustration and non-response of participants uncomfortable with a web-based format and complicate the design and implementation of web-based surveys (Dillman & Bowker, 2001).

While web-based surveys offer new opportunities and resources for survey research, the advantages must be measured in terms of their applicability with a given population. The purpose here is not to dispute the advantages of web-based surveys but to put the advantages into proper perspective. Web-based surveys are very different from other survey methods in their execution. Before assuming web-based surveys are the most advantageous method for surveying a target population, it should be determined if those advantages exist within that population.

Disadvantages

The disadvantages of web-based surveys concern the inability to compensate for four common errors of survey research: coverage error, sampling error, measurement error and nonresponse error (Dillman & Bowker, 2001). The purpose of survey research is to describe what people think or do (Cooper, 2000). An accurate description of a population is reliant on surveying a representative sample and obtaining accurate responses from the sample. Salent and Dillman (1994) discuss four sources of error in survey research that result in an inaccurate description of a population. These errors are:

- Coverage Error: The sample frame drawn from a population does not represent all elements of a given population.
- Sampling Error: The result of surveying only one subset of the population rather than the entire population.
- Measurement Error: A respondent's answer to a question is different from the actual answer due to poor question

wording, poor interviewing, survey mode effects and/or some aspect of the respondent's behavior.

- Nonresponse Error: Those who did not respond to a questionnaire are different from those who did respond to the questionnaire in a way that is important to the study. If the non-respondents had responded, they would have provided different answers to the survey questions than those who did respond to the survey.

Coverage Error

Internet access is not ubiquitous. According to the September 2001 U.S. Census Bureau's Current Population Survey, 65.6 percent of the U.S. population were computer users (National Telecommunications & Information Administration, 2002). Use of the Internet is significantly higher among higher educated and higher income populations (National Telecommunications & Information Administration, 2002). Furthermore, computer and Internet use rates fall significantly among populations older than 55 (National Telecommunications & Information Administration, 2002).

Obviously, coverage of the population is a great concern when conducting web-based surveys. It is easy to see how not everyone included in a target population of a study would be represented in the sample frame if the Internet is the only mode of delivery of a survey. To accurately depict and to make inferences of a population, a probability sample must be representative of the target population. Without accurate representation, a sample frame drawn strictly from Internet users results in merely a convenience sample for which statistical inferences cannot be made about the target population. The aforementioned census data establishes that the proportion of a population that can be reached with web-based surveys is not universal, therefore, unlikely to be representative of all populations. Further, the difference in demographics of those who can participate in a web-based survey from those who lack the means to participate in a web-based survey is significant. Survey researchers who employ web-based surveys as a mode of data collection suggest that target populations must be clearly defined and authenticated before conducting web-based research to minimize the possibility of coverage error (Shannon, e. al., 2002). A representative sample of a target population may only be possible with a multimode survey approach utilizing a combination of print, telephone, interview, and web-based venues (Dillman, 2000).

Sampling Error

While coverage error refers to people missing from the sample frame (those without Internet or Web access in the case of web-based surveys), sampling error occurs during the selection of a sample from the population (Salent and Dillman, 2001). A sampling frame is a list of persons(or identifiers) from which a sample is drawn (Salent and Dillman, 1994). The difficulty is assuring that every member of a population is included in a sampling frame. For example, the uniformity and regional area code of telephone numbers allow a method of random selection to be devised for telephone surveys. Furthermore, telephone directories provide comprehensive lists of the telephone addresses of a regional population.

E-mail is the primary and best form of contact for notifying participants of a web-based survey. The lack of uniformity or regional code in e-mail addresses prevents the development of any such random sampling selection. Sampling frames using listed e-mail addresses exclude numerous Internet users who do not appear in online directories. Online e-mail directories frequently rely on volunteer registration rather than automatic, registration prevalent with telephone subscriptions. As a result, no method exists where a representative, random sample of Internet users can be drawn from a diverse population.

However, within organizations (for example a state government education agency or a local school district) whose entire survey population has Internet access and e-mail, sampling error can be contained. Within confined organizations, generally, a comprehensive list of e-mail addresses does exist online and there is a uniform code for assigning e-mail addresses. Conducting a census of the entire population rather than a sample is possible within such restricted populations. Sampling issues would be no greater with web-based surveys than print surveys within these contained populations.

Measurement Error

Measurement errors occur during the data collection process. Measurement errors in surveys are deviations of the respondent's answers from the actual answers (Salent and Dillman, 1994). Salent and Dillman (1994) list three sources of measurement errors pertinent to web-based surveys: the survey method, the questionnaire design, and the respondent. Salent and Dillman (1994) found that different

survey methods can yield very different answers for the same question. The method of survey places different demands on the respondent. Self-directed surveys allow the respondent to control the pace, and direction of the completion of a survey. Moreover, the participant has more control over the response to a question or the choice to not respond to a question.

While wording of questions can have an impact on survey response, the recommendations for general wording and design of questions for web-based surveys is no different than for print surveys. A poorly designed question is a poorly designed question no matter what medium the survey is delivered. Rea and Parker (1997, p.45 - 63) provide several recommendations for phrasing and formatting survey questions.

Flow and design of web-based surveys and its impact on measurement errors has been the topic of recent studies (Dillman, Tortura, and Bowker, 1998; Dillman, Tortora, and Bowker, 1998; Crawford, Couper, and Lamias, 2001; Couper, M., Traugott, and Lamias, M., 2001). The appearance of a web-based survey can vary from respondent to respondent because of the look and feel of different web browsers, user preferences, and variations in hardware configurations. Design of Web-based surveys becomes much more important because of graphic tools available to the designer (color, sound, images, animation, etc.), the varying computer skills of respondents and the variation in appearance of a web-based survey from computer to computer (Cooper, 2001). In a study of college students' attitudes on Affirmative Action, Couper, Traugott, and Lamias (2001) experimented with different layouts and designs of a web-based survey. They found that students completed the survey faster and answered more questions with multiple-item screens. They also saw a stronger correlation among items on the same screen than when questions were presented one screen at a time. Dillman and Bowker (2001) noted that excessive navigational controls that require a respondent to perform several steps before moving to the next question lead to frustration and abandonment by the respondent.

Nonresponse Error

Nonresponse error refers to the participants in a sample unwilling or unable to complete the survey. Generally, web-based surveys have a lower response rate than mail surveys (Solomon, 2001). Several reasons for lack of response to web-based surveys have been offered. Crawford, Couper, and Lamias (2001) noted that lack of experience of

researchers in achieving high response rates may be one factor. Dillman and Bowker (2001) suggest that simpler web designs that load quickly and easily result in higher response rates. More complicated web-based surveys that take longer to load and cause compatibility problems for older computers may result in abandonment before the respondent ever actually begins a survey. It is crucial that web-based surveys provide a format that is easy to load and is compatible with a variety of computer systems. Solomon (2001) presents data from a meta-analysis that follow-up contacts with nonrespondents and personalized contacts increased the response rate to web-based surveys.

Web-Based Survey Design

Previous studies have shown that the design of a web-based survey can affect who completes the survey (Dillman and Bowker, 2001), the number of questions completed within the survey (Salent and Dillman, 1994), and the actual answers from the respondent (Couper, Traugott, and Lamias, 2001). With the graphic and multimedia capabilities of the computers, the survey researcher has an almost unlimited set of design choices in developing web-based surveys. As a result, the design and format of web-based surveys is highly variable. Clear standards for the design of web-based surveys are lacking. However, studies on the affects of certain design features on response do provide some guidance on survey design.

Multi-page vs. Single-page Layout

One of the central issues in web-based survey design is the advantage and disadvantage of the multi-page layout of a web-based survey (Dillman, 2000; Couper, Traugott, and Lamias, 2001). A multi-page layout refers to only a portion of the survey questions displayed on a web page. As the respondent completes a question, they are presented with another question. The respondent does not see other questions on a survey until the displayed question(s) is/are completed. Variations of multi-page layouts group same type questions or same topic questions on a single web page.

A single-page design follows the more traditional pattern of print surveys. All the questions of the survey are on a single web page. The respondent can preview all of the questions at one time. The respondent navigates through the survey using the scroll bar. Dillman (2001) suggests that multi-page layouts prevents the respondent from gaining the overall content of the survey. Without the

ability to preview the entire survey before answering the questions, the respondent has no means for developing a sense of meaning or purpose of the survey. Studies also reveal that multi-page surveys take significantly longer to complete than single-page surveys (Manfreda, Batagelj, and Vehova, 2002). However, multi-page designs enable the researcher to create skip patterns and branching unobservable to the respondent (Couper, Traugott, and Lamias, 2001). Designed properly multi-page layouts have the potential of making a longer, more complicated survey easier for the respondent. Ultimately, the decision to construct a multi-page or a single-page layout is dependent on several variables: the computer skills of the respondents, the length of the survey, the complexity of the survey and if multiple survey modes are being conducted (Dillman, 2000).

Progress Indicators

Dillman and Barker (2001) found that one source of frustration for respondents in web-based surveys was not knowing how close they were to the end of the questionnaire. This was especially true with multi-page layouts where the respondent had no indication of how long the survey was. Recent studies have examined the use of progress indicators that inform the respondent how much of the survey they have completed. Progress indicators may take the form of a pie chart, or horizontal bar in one corner of the screen illustrating the percentage of the survey that is complete. The purpose of progress indicators is to motivate the respondent to complete the survey. Studies have revealed mixed results in higher completions rates with progress indicators (Crawford, Couper, and Lamias, 2001). In a study of college students' attitude toward affirmative action, Couper, Traugott, and Lamias (2001) found no significant difference in the number of partial response or survey abandonment between respondents who had a progress indicator within their web-based survey and respondents who had no progress indicator. Couper, et. al. hypothesized that the additional download time needed to complete surveys with the progress indicator may have counteracted with the affect of including the progress indicator. Other studies have also found that demographics and the length of the survey are a factor in the usefulness of a progress indicator (Crawford, Couper, and Lamias, 2001).

Layout

The skills required to create web-based surveys are different from the skills to create other types of surveys (Shannon, et. al., 2002).

Depending on which software product, online survey tool or programming language used to develop a web-based survey, moderate to expert skills are required. Additionally, knowledge of good web page design is necessary to create an interactive, easily navigated web survey (see Criteria For Evaluating Web Sites, Appendix A). Furthermore, more research and knowledge are needed on the impact of web design and web features on response error and measurement error (Dillman, 2000). Due to the technological knowledge and skill required to develop web-based surveys, leadership in the development of web-based surveys has originated from the technology professional rather than research professionals. The challenge for survey methodologists is to merge sound principles of survey design and implementation with sound principals of web design (Dillman, 2000; Dillman & Bowker, 2001).

The most thorough attempt to provide guidelines for web-based survey design was done by Dillman, Tortura and Bowker (1998). Appendix B. lists the fourteen principles constructed and the type of survey error they address. The recommendation to address sampling error with a probability sample is to limit access to the survey by assigning each respondent a PIN number. Other principles addressing sampling and coverage errors are constructing web questionnaires that scroll from question to question and providing an indicator of where the respondent is in the survey. Most of the principles aim at reducing frustration of the respondent with hardware incompatibility and slow data access speeds and reducing nonresponse error. Overall, these principles encourage simplistic design of surveys. Dillman, Tortura and Bowker (1998) readily admit that these principles were based mostly on observation and that empirical studies are still needed to verify and improve upon this list.

Conclusion

The research on web-based surveys to date indicates that there are many possibilities for the use of web-based surveys in methodological research. More empirical studies need to be conducted that provide recommendations for developing web-based surveys that control for coverage error, sampling error, measurement error and nonresponse error. Based on the advice from numerous research professionals, web-based surveys are best employed with well-defined, targeted populations where Internet access is widely available (Shannon, e. al., 2002).

With the numerous survey development products now available, the construction of web-based surveys is dramatically easier to construct and deploy. However, the development of survey software and online survey products make the need for empirically sound design recommendations more critical. Based on the research thus far on web-based surveys, the following features are recommended for online survey products:

1. Provide the option to include a progress indicator on the survey.
2. Provide a method for respondents to print a printer-friendly version of the survey.
3. Provide the researcher flexibility in the design and formatting of the survey.
4. Provide methods of authentication for probability samples such as password protection or PIN numbers.

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Appendix A. CRITERIA FOR EVALUATING WEB SITES
(Southern Regional Education Board)

Content

Accuracy:

Error-free information

Current information

Updated frequently

Recent "last" update

Objective, balanced presentation of information

Bias-free viewpoints and images

Correct use of grammar, spelling, and sentence structure

Primary outlink (link that takes you to additional site) content is relevant, authentic, and appropriate

Authority:

Expertise/reputation of author/designer

Contact information for author/designer

Expertise/reputation of host site

Appropriateness:

Concepts and vocabulary relevant to students' abilities

Information relevant to the North Carolina K-12 curriculum

Interaction compatible with the physical and intellectual maturity of intended audience

Scope:

Information of sufficient scope to adequately cover the topic for the intended audience

Logical progression of topics within original site (site being evaluated) and primary outlinks

Information offered not easily available in other sources

Technical Aspects:

Navigation:

Ready access to site; site not overloaded

Images load within reasonable timeframe

Intuitive icons, menus, and directional symbols that foster independent use

Inlinks (links that take you to locations within the original site) that allow easy navigation throughout the site

Standard multimedia formats

Logical options for printing/downloading all or selected text and graphics

Presentation:

Site follows good graphic design principles

Screen displays uncluttered and concise

Captions, labels, or legends for all visuals

Legible text and print size appropriate for the intended audience

Graphics and art functional, not merely decorative

Information presented through text, motion, still images, and sound

Information presented in a manner to stimulate imagination and curiosity

Product advertising not intrusive

Appendix B: Principles for the design of web surveys (Dillman, Tortura and Bowker, 1998)

Principle	Sampling	Coverage	Measurement	Non-Response
1. Introduce the web questionnaire with a welcome screen that is motivational, emphasizes the ease of responding, and instructs respondents on the action needed for proceeding to the next page.				X
2. Provide a PIN number for limiting access only to people in the sample.	X	X		
3. Choose for the first question an item that is likely to be interesting to most respondents, easily answered, and fully visible on the first screen of the questionnaire.				X
4. Present each question in a conven-tional format similar to that normally used on paper self- administered questionnaires.			X	X
5. Restrain the use of color so that figure/ground consistency and read-ability are maintained, navigational flow is unimpeded, and measurement properties of questions are maintained.			X	
6. Avoid differences in the visual appearance of questions that result from different screen configurations, operating systems, browsers, partial screen displays and wrap-around text.		X	X	X
7. Provide specific instructions on how to take each necessary computer action for responding to the questionnaire and other necessary instructions at the point where they are needed.				X
8. Use drop-down boxes sparingly, consider the mode implications, and identify each with a "click here" instruction.			X	
9. Do not require respondents to provide an answer to each question before being allowed to answer any subsequent ones.				X
10. Provide skip directions in a way that encourages marking of answers and being able to click to the next applicable question.			X	
11. Construct web questionnaires so they scroll from question to question unless order effects are a major concern, and/or telephone and web survey results are being combined.		X	X	X
12. When the number of answer choices exceeds the number that can be displayed in a single column on one screen, consider double-banking with an appropriate grouping device to link them together.			X	
13. Use graphical symbols or words that convey a sense of where the respondent is in the completion process, but avoid ones that require significant increases in computer memory.		X		X
14. Exercise restraint in the use of question structures that have known measurement problems on paper questionnaires, e.g.,			X	X

check-all-that-apply and open-ended questions				

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